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Volume 3

Interface Control Documents

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Part 1
AMPS Payload to Shuttle ICD

# Atmospheric, Magnetospheric and Plasmas in Space (AMPS) Spacelab Payload Definition Study




MARTIN MARIETTA

Bendix

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# ATMOSPHERIC, MAGNETOSPHERIC AND PLASMAS IN SPACE (AMPS) SPACELAB PAYLOAD DEFINITION STUDY

Prepared for

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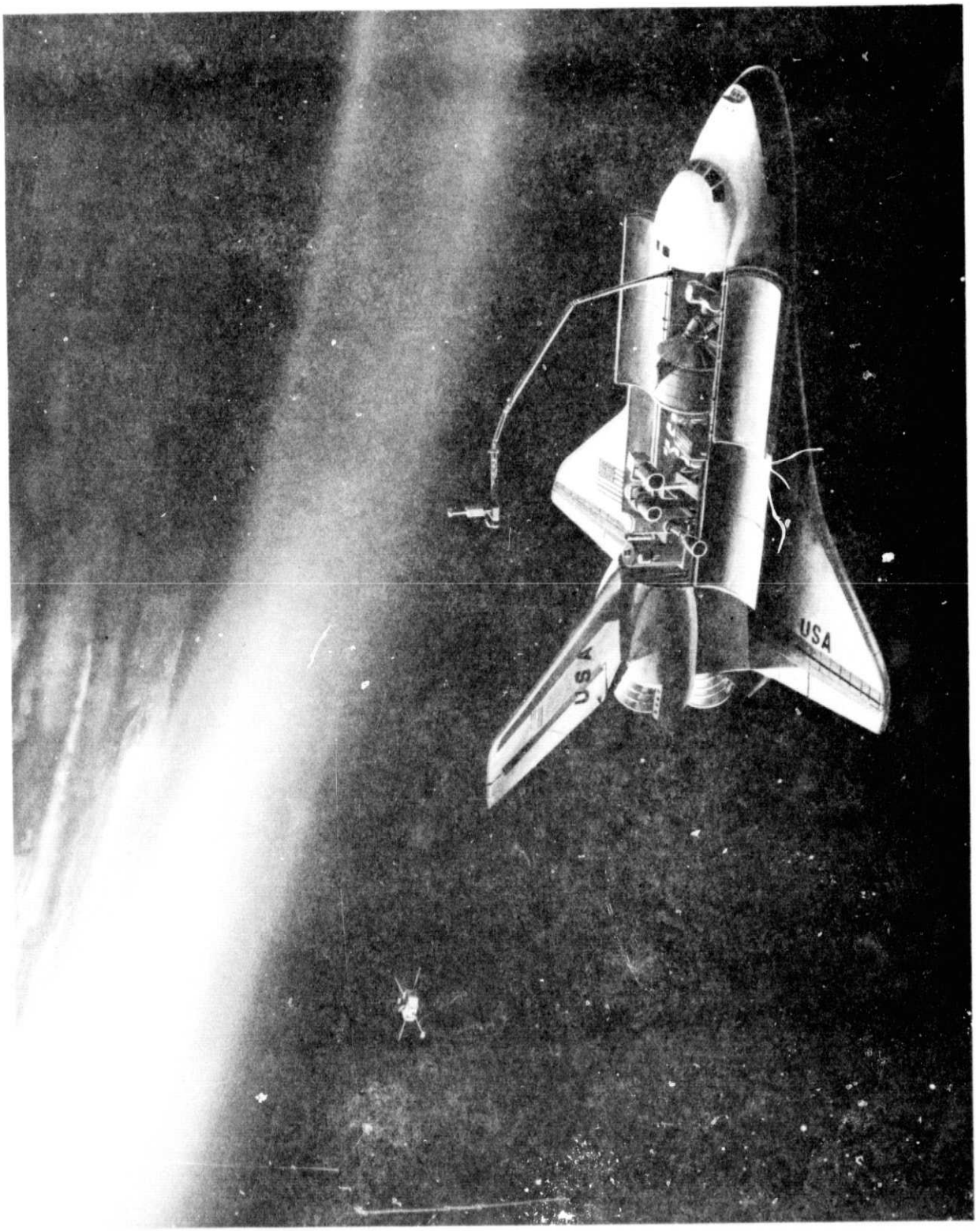


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## FOREWORD

The AMPS final report is submitted by Martin Marietta in accordance with Data Procurement Document Number 486, Revision A, of Goddard Space Flight Center Contract NAS8-31689.

The AMPS final report consists of seven volumes. They are:

| | | |
|---|---|---|
| Volume 1 | DR MA-05-A | Executive Summary Report |
| Volume 2 | DR SE-01-A | Mission Support Requirements Document |
| Volume 3 | DR SE-02-A | Interface Control Documents |
| | Part 1 | AMPS Payload to Shuttle ICD |
| | Part 2 | AMPS Payload to Spacelab ICD |
| | Part 3 | AMPS Payload to Instruments ICD |
| Volume 4 | DR SE-03-A | Specifications |
| | Part 1 | AMPS Program Specification |
| | Part 2 | Labcraft Payload General Specification |
| | Part 3 | Labcraft Instrument Systems General Specification |
| Volume 5 | DR SE-04-A | Deleted per Paragraph I, Attachment A, Request for Proposal under Changes Clause, dated 8/31/76 |
| Volume 6 | DR SE-05-A | Instruments Functional Requirements Document |
| Volume 7 | DR MA-04-A | Program Analysis and Planning for Phase C/D Document |
| Volume 8 | DR MF 003R-A | Program Study Cost Estimates Document |

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## 1.0 PURPOSE

The AMPS to Space Shuttle Vehicle Interface Control Document is a general document, which will be used as a format guide for defining interfaces of specific AMPS Missions. This document is meant to be supplementary to the Space Shuttle Accommodations Handbook in that it will only define interfaces which are not discussed in the handbook to the level required for design purposes. Any time the AMPS interface is within the allocations derined in the handbook, it will govern the interface and that information will not be repeated here. Furthermore payload interface data which pertains to AMPS and is controlled by the Space Shuttle/Spacelab ICDs will control this payload and neither will it be repeated.

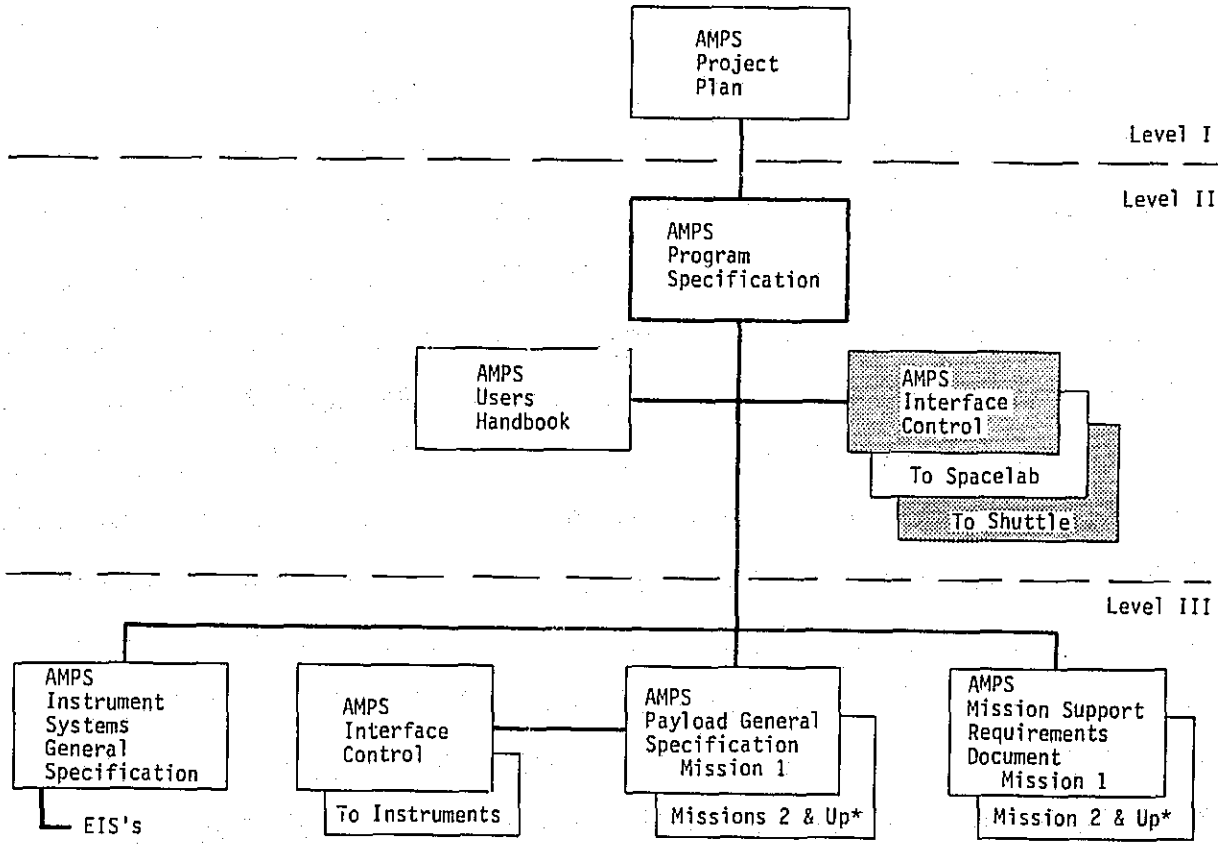
This approach to defining the AMPS to Space Shuttle interfaces will result in minimum AMPS documentation and will avoid redundancy with existing program documents.

Figure 1-1, the AMPS Top Level Requirements Tree, illustrates this ICD by a shaded area and its relationship to the total AMPS technical documents. Other interface documents shown in the figure are the Level II, AMPS to Spacelab ICD and the Level III, AMPS to Instruments ICD.

## 1.1 SCOPE

This document defines physical, functional and operational interfaces between the Space Shuttle Orbiter and the AMPS payload for the

ground handling and test phases, prelaunch, launch and ascent, operational, stowage and re-entry and landing activities.




* Reissue or Addenda, depending on magnitude of change.

Figure 1-1 AMPS Top Level Requirements Tree

## 2.0 APPLICABLE DOCUMENTS

Shuttle Vehicle/Spacelab Mechanical ICD, 2/16/76, ICD-2-5101

Shuttle Vehicle/Spacelab ECS/Thermal ICD, 2/16/76, ICD-2-5201

Shuttle Vehicle/Spacelab Avionics ICD, 2/16/76, ICD-2-5301

Shuttle Vehicle/Spacelab Software ICD, _____, ICD-2-5401

Space Shuttle System Payload Accommodations Handbook, Level II Program Definition and Requirements, JSC-07700, Vol XIV, Rev D, Change 16, 7/8/76

Space Shuttle System Payload Interface Verification, Volume I, General Approaches and Requirements, JSC-07700-14-PIV-01, 12/15/76

## 3.0 INTERFACE REQUIREMENTS

### 3.1 MECHANICAL/STRUCTURAL

#### 3.1.1 PAYLOAD INSTALLATION

This section will identify the Orbiter attachment points which the AMPS Payload will use. It will also identify the pallet configuration, i.e., whether there is a 3 pallet train or a 1-2 combination.

#### 3.1.2 AMPS ENVELOPE

This section will illustrate the operational envelope of AMPS equipment which extends beyond the nominal payload bay envelope.

##### 3.1.2.1 PLATFORM MOUNTED INSTRUMENTS OPERATIONAL ENVELOPE

This section will illustrate the static and dynamic operational

envelope of instruments mounted on a pointing platform.

3.1.2.2 REMOTE MANIPULATOR SYSTEM (RMS)/AMPS ENVELOPE

This section will illustrate static and dynamic operational envelope(s) of the RMS/AMPS Instrument Systems. It will show envelopes of items such as the Environmental Sensing Package (ESP), Beam Diagnostic, Plasma Wake Generator and the Plasma Wake Diagnostic Packages as they sweep from their stowed to and including their operational location and return to stowage.

3.1.2.3 EJECTED INSTRUMENT SYSTEMS ENVELOPES

This illustration will show the envelopes which ejected instruments will sweep as they clear the payload bay/Orbiter. The Instrument Systems currently being planned for ejection are the ESP, RF Receiver and the Gas Chemical Release Modules. Platform mounted instruments and the RMS/AMPS Instrument Systems will be designed for contingency jettison, if they are unable to be returned to the payload bay.

3.1.3 RMS END EFFECTOR/INSTRUMENT SYSTEM INTERFACES

Illustrations will show the interfaces of the RMS End Effector to AMPS Instrument Systems. If design mechanisms are required by

the RMS/operator for alignment during removal/replacement of instrument systems, they will be shown.

### 3.1.4 ORBITER CREW COMPARTMENT/AMPS LOOSE EQUIPMENT

This section will describe installation of AMPS loose equipment stowage in the Orbiter crew compartment of any controls and displays interfaces, if required. (NOTE: Most of the volume available (~95% is in mid-deck and the only items identified thus far are the weight and volume for 2 crewmen and their expendables for the entire mission.)

### 3.1.5 CONTAMINATION/CLEANLINESS

Contamination and cleanliness interface requirements between AMPS and the Orbiter are identified in the Space Shuttle Accommodation Handbook and the Shuttle Vehicle/Spacelab Mechanical ICD, ICD-2-5101.

## 3.2 ELECTRICAL

All electrical interfaces from AMPS are with Spacelab and are covered in the Spacelab to AMPS ICD.

## 3.3 THERMAL

### 3.3.1 ENVIRONMENTAL CONTROL SYSTEM (ECS)

3.3.1.1 FLIGHT DECK/AMPS

Any AMPS Equipment located in the Orbiter Aft Flight Deck which requires cooling will be discussed here. The cooling capability is 0.35 KW, but may be extended to an average of 0.75 KW and a peak of 1 KW depending on the utilization of the Payload heat exchanger.

3.3.2 ACTIVE THERMAL CONTROL SYSTEM (ATCS)

The use of the Shuttle Orbiter ATCS by AMPS will be covered in the Shuttle/Spacelab ECS/Thermal ICD, ICD-2-5201.

3.4 ENVIRONMENTS

The environments (natural and induced) which AMPS equipment will be exposed to are covered in the Spacelab to AMPS ICD and the Shuttle Vehicle/Spacelab ICDs.

3.5 CONTROLS AND DISPLAYS

This section will define the functional and operational interfaces of AMPS/Orbiter Controls and Displays. It will present a brief functional analysis of the crew to dedicated AMPS C&D (if required) and Orbiter C&D within the Orbiter Aft Crew Station.

## 3.6 COMMUNICATIONS

The AMPS Deployed Package/Orbiter RF Communications interface link will be discussed in this section. The Orbiter Ku-Band Radar will be used for tracking AMPS Deployed Packages, such as the Gas/Chemical Release Packages, the ESP and the RF Receiver. Interface parameters, such as power, frequency, range, range rate, angle, angle rate will be discussed.

## 3.7 ORBITER ATTITUDE AND POINTING CONTROL SYSTEM (APCS)/AMPS INTERFACES

In order to maintain the AMPS APCS capability within design limits it is necessary to control the input disturbances.

### 3.7.1 CREW MOTION DISTURBANCES

The torques created by crew motion disturbances shall not exceed TBD.

### 3.7.2 REACTION CONTROL SYSTEM (RCS) THRUSTER FIRINGS

The torques created by RCS thruster firings shall not exceed TBD.

### 3.7.3 SOFTWARE

APCS Software requirements between AMPS and Orbiter are covered in the AMPS to Spacelab ICD and the Shuttle Vehicle/Spacelab Software ICD, ICD-2-0540..

## 3.8 SAFETY

This section will identify safety interfaces between the AMPS and Orbiter. Items which will be examined are deployment mechanisms to be certain that deployed packages are given adequate deployment ( $\Delta$ V, orientation, direction, etc) required to cause no hazards to the Shuttle; pyrotechnic circuitry to be certain no grounds, shorts or operational lapses could cause inadvertent premature firing; capture mechanisms to be sure the instruments can survive crash landings; charging of the Shuttle by the Electron Accelerator to ascertain no crew/hardware hazard exists.